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Indian Standard

GRINDING MEDIA ROLLED/FORGED CARBON AND CARBON-CHROMIUM STEELS — SPECIFICATION

भारतीय मानक

पेषण माध्यम – वेल्लित/गढ़े हुए कार्बन एवं कार्बन-क्रोमियम इस्पात की विशिष्टि

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

October 1989 **Price Group 2**

Steel Forgings Sectional Committee, SMDC 21

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards on 10 April 1989, after the draft finalized by the Steel Forgings Sectional Committee had been approved by the Structural and Metals Division Council.

Grinding media material is required to possess high strength and hardness in service and they should be capable of withstanding extreme pressure and heavy shock loads. This standard covers requirements for rolled/forged carbon and carbon-chromium steel balls/cylindrical cylpebs to be used in wet and dry grinding of high abrasive materials namely, Copper, zinc, aluminium ores, colour pigments, metal oxides and carbides, bauxite, coal, coke, slags, etc.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number or significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

GRINDING MEDIA ROLLED/FORGED CARBON AND CARBON-CHROMIUM STEELS — SPECIFICATION

1 SCOPE

1.1 This standard covers the requirements of carbon and carbon-chromium steels rolled/forged grinding media (balls/cylindrical cylpebs) for use in cold or hot, wet or dry grinding purposes.

2 REFERENCE

2.1 The following Indian Standards are necessary adjuncts to this standard.

IS No.	*Title*
IS 228 (in parts) :	Methods of chemical analysis of pig iron, cast iron and plain carbon and low alloy steels (*revised*)
IS 1387 : 1967	General requirements for the supply of metallurgical materials (*first revision*)
IS 1500 : 1983	Method for Brinell hardness test for metallic materials (*second revision*)
IS 1586 : 1988	Method for Rockwell hardness test for metallic materials (Scales A-B-C-D-E-F-G-H-K) (*second revision*)
IS 1956 (Part 6) : 1976	Specification for forging (including drop forging) (*first revision*)
IS 3668 : 1981	Specification for liverpool twill (L-twill) cloth
IS 3703 : 1980	Code of practice for magnetic particle flaw detection (*first revision*)
IS 4905 : 1968	Methods for random sampling

3 TERMINOLOGY

3.1 For the purpose of this standard, definitions of related terms shall be as given in IS 1956 (Part 6) : 1976.

4 SUPPLY OF MATERIAL

4.1 General requirements relating to the supply of material shall be as laid down in IS 1387 : 1967.

5 MANUFACTURE

5.1 Rolled/forged grinding media material shall be manufactured from killed steel made by the open hearth, electric or any other approved process.

5.2 Sufficient discard shall be made from each ingot to ensure freedom from piping, segregation and any other harmful defects.

5.3 The material shall be rolled/forged under rolls/hammer to work the metal throughout its section within the range of rolling/forging temperature. Suitable reduction factor should be taken into account so that sufficient breaking up of the as cast structure, welding of inside piping and refinement of the grain structures are obtained. Material shall not be overheated.

5.4 The material after rolling/forging shall be given suitable heat treatment. The balls may be supplied either in normalized or hardened and tempered condition to obtain the required hardness and micro structure. The method of heat treatment shall be subject to mutual agreement between the manufacturer and the purchaser.

5.5 The purchaser shall specify in the enquiry, contract or order, the type of balls required showing dimensions, hardness range, surface finish and use. Any other requirement shall also be specified.

6 WORKMANSHIP AND FINISH

6.1 Rolled forged grinding media material shall be in accordance with the sizes and tolerances specified in the standard or as agreed to between the purchaser and manufacturer.

7 CHEMICAL COMPOSITION

7.1 Ladle analysis of steel shall conform to one of the following compositions:

Constituent percent	C-98	103 Cr
Carbon	0·90-1·20	0·95-1·10
Manganese	0·45-0·70	0·25-0·45
Silicon	0·30, *Max*	0·10-0·35
Sulphur	0·06, *Max*	0·035, *Max*
Phosphorous	0·06, *Max*	0·035, *Max*
Chromium		1·40-1·60

7.1.1 The ladle analysis of steel shall be carried out by the method specified in the relevant parts of IS 228 or any other established instrumental/chemical method. In case of dispute, the procedure specified in the relevant parts of IS 228 shall be the referee method.

7.2 The manufacturer shall carry out analysis from each lot of steel and when required by the purchaser, shall supply a certified analysis of a sample of steel from each lot.

7.3 If required by the purchaser, the product analysis should be carried out of the sample representing each lot. Permissible variation in product analysis from limits specified in **7.1** shall be as given below:

Constituent	*Variation* percent
Carbon	±0·03
Manganese	±0·03
Silicon	±0·02
Sulphur	±0·005
Phosphorous	±0·005
Chromium	±0·05

NOTE — Variations shall not be applicable both over and under the specified limits in several determinations in a heat.

8 FREEDOM FROM DEFECTS

8.1 All grinding media material shall be free from defects that affect the utility and no surface conditioning except grinding shall be permissible.

9 MICRO STRUCTURE

9.1 Micro structure of hardened and tempered balls/cylindrical cylpebs shall be such as to have a minimum of 90 percent tempered martensite at the surface and a minimum of 50 percent tempered martensite at the core.

9.2 Normalized balls/cylindrical cylpebs shall have a structure of predominantly fine pearlite and carbide.

10 HARDNESS

10.1 The balls/cylindrical cylpebs which have been hardened and tempered shall have a minimum hardness of 60 RC at the surface and 55 RC at the core when tested in accordance with IS 1586 : 1988.

10.2 Normalized balls/cylindrical cylpebs shall have a minimum hardness of 300 HB when tested in accordance with IS 1500 : 1983.

10.3 For special application in case of both hardened and tempered, and normalized, the hardness value shall be as mutually agreed to between the purchaser and the supplier.

11 SIZE

11.1 Grinding media material shall be rolled/forged in the following sizes:

a) *Balls of Diameter* — 25, 30, 40, 50, 60, 65, 70, 75, 80, 90, 100, 120 mm, and

b) *Cylindrical Cylpebs* (*Diameter* × *Height*) — 15 mm × 15 mm, 18 mm × 18 mm, 20 mm × 20 mm, 22 mm × 22 mm, 25 mm × 25 mm,

NOTE — Grinding media balls/cylindrical cylpebs may also be supplied in other sizes as agreed to between the purchaser and the manufacturer.

12 TOLERANCES ON SIZE

12.1 Variation in size shall not exceed the following limits:

Shape and Size	*Tolerance on Diameter* mm
a) Balls for sizes 50 mm dia and below	±2·50
b) Balls for sizes above 50 mm dia	±3·00
c) Cylindrical cylpebs	±1·50

13 DROP TESTING

13.1 Integrated Testing

1 percent or 3 balls/ cylindrical cylpebs which ever is higher would be subjected to one of the following tests:

a) Magnetic particle inspection, according to IS 3703 : 1980,

b) Dye penetration test as in IS 3668 : 1981.

c) Drop test by subjecting 3 balls/cylindrical cylpebs in a batch and a drop on a steel plate from a height of 3 metres.

NOTE — In case of drop test, breakage or fragmentation will be a cause of rejection. Any defects exposed in (a) and (b) will be a cause of rejection.

13.2 Retest

In case of failure, double the number of sample size shall be permitted for retesting. The entire sample shall pass in retesting for acceptance.

14 PERFORMANCE GUARANTEE

14.1 Balls/Cylindrical Cylpebs

Breakage	1 percent —	Normal
	1-3 percent —	Replacement of broken balls.
Above	3 percent —	Entire lot to be replaced.

15 SAMPLING

15.1 Method for sampling of grinding media materials and the criteria for conformity shall be as given in Annex A.

16 PACKING

16.1 Unless otherwise specified, the material shall be supplied in loose unpacked condition.

17 MARKING

17.1 In case the material is supplied in packed condition, the container shall be legibly marked with the following:

a) Name of manufacturer or trade-mark, and

b) Grade and size of grinding media.

17.1.1 In case the material is supplied loose, the method of identification shall be mutually agreed upon at the time of enquiry and order.

ANNEX A

(*Clause* 15.1)

SAMPLING AND CRITERIA FOR CONFORMITY OF GRINDING MEDIA BALLS/CYLINDRICAL CYLPEBS

A-1 VISUAL AND DIMENSIONAL CHARACTERISTICS

A-1.1 Rolled/forged grinding media balls/cylindrical cylpebs of one size having similar composition and subjected to similar heat treatment shall constitute a lot.

A-1.1.1 The number of balls/cylindrical cylpebs to be selected at random from each lot shall depend upon the size of the lot and shall be in accordance with *col 1 and 3 of Table 1*.

A-1.1.2 These balls/cylindrical cylpebs shall be selected from the lot at random. In order to ensure the randomness of selection, procedure given in IS 4905 : 1968 may be followed.

A-1.2 Each of the items selected according to **A-1.1.1** shall be inspected for visual and

Table 1 Scale of Sampling and Permissible Number of Defectives

(*Clauses* A-1.1.1, A-1.2 *and* A-2.1)

Lot Weight	State	Visual and Dimensional			Hardness and Micro Structure Characteristics		
		Sample	Acceptence Number	Rejection Number	Sample Size	Acceptance Number	Rejection Number
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Up to 2 tonnes	First	20	0	3	5	0	2
	Second	20	3	4	5	1	2
Above 2 tonnes and up to 5 tonnes	First	32	1	4	8	0	2
	Second	32	4	5	8	1	2
Above 5 tonnes and up to 10 tonnes	First	50	2	5	13	0	3
	Second	50	6	7	13	3	4

dimensional requirements. Any item failing to meet either of the characteristics shall be considered as defective. The lot shall be considered as conforming to the requirements if the number of defectives found in the sample is less than or equal to the acceptance number (*see* col 4 of Table 1) and shall be rejected if it is greater than or equal to the rejection number (*see* col 5 of Table 1). If the number of defectives lies between the acceptance number and the rejection number; a second sample of the same size as the first shall be taken at random and examined. The number of defectives found in the first and second samples shall be combined and if the combined number of defectives is less than or equal to the corresponding acceptance number of the second sample, the lot shall be declared as conforming to the requirements; otherwise not.

A-2 HARDNESS AND MICRO STRUCTURE

A-2.1 The lot which has passed the visual and dimensional requirements shall next be tested for hardness and micro structure. For this purpose, the number of balls/cylindrical cylpebs to be selected shall be in accordance with col 1 and 6 of Table 1.

A-2.2 The criteria for conformity for these tests is similar to that given in **A-1.2**.

A-3 RE-INSPECTION

A-3.1 The manufacturer has the right, if he so desires, to sort the balls/cylindrical cylpebs in the rejected lot by 100 percent inspection and to put up a revised lot for re-inspection.

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BUREAU OF INDIAN STANDARDS

Headquarters :

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 331 01 31, 331 13 75

Telegrams : Manaksanstha
(Common to all Offices)

Regional Offices :	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	331 01 31 331 13 75
Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola CALCUTTA 700054	36 24 99
Northern : SCO 445-446, Sector 35-C, CHANDIGARH 160036	2 18 43 3 16 41
Southern : C. I. T. Campus, IV Cross Road, MADRAS 600113	41 24 42 41 25 19 41 29 16
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